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(54) **Method and apparatus for controlling zero adjustment of weight sensor.**

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SOVIET JOURNAL OF INSTRUMENTATION AND CONTROL, no. 3, March 1969, page 21, London, GB; A.T. GAMBURER et al.: "Analogue-to-code converter used with strain gauge hopper-weighers"

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Description

This inv ntion relates to zero-point adjustment f weighing machines.

It is often required to accurately weigh out articles, which have unit weights that differ from one to another, into fixed quantities while at the same time limiting the articles in number. Examples of such articles are vegetables and fruits, confectioneries, perishables, fabricated articles, etc. When the weighing out such articles it is general practice to make use of a combinatorial scale that relies upon a computer. A scale of this type is referred to as a computer scale.

Such a computer scale, as illustrated in Fig. 1 of the accompanying drawings, is composed of a plurality of weighing machines A_1, A_2, ..., A_n, weighing hoppers B_1, B_2, ..., B_n associated with respective ones of the weighing machines, a common guide chute C, a pool hopper D, and buckets E operatively associated with a packing machine or the like.

In a computer scale of this kind each of the weighing hoppers B_1, B_2, ..., B_n is supplied with articles to be weighed. The articles in each hopper are then weighed, and different combinations of the weighed values are added in each weighing cycle, with the number of weighed values in each combination being either arbitrary or predetermined. The sum of the weights in each combination is compared with a set target weight, whereby the weight combination that gives the target weight or the value closest thereto is found is each weighing cycle. This combination of weights is referred to as the best combination. When the best combibation is found in the manner described, only those weighing hoppers of the weighing machines that are specified by the best combination (in other words, the best combination of weighing hoppers) are opened in response to an electric signal, thereby discharging their contents into the common guide chute C which in turn guides the articles to the pool hopper D where they are collected. The pool hopper D is subsequently actuated to introduce the articles into the bucket E which carries the articles to a packing machine or the like.

In weighing articles using the aforementioned computer scale, a wide variety of matter, such as powder, oil, salt and other residua originating from the weighed articles, attaches itself to the wall of the weighing hoppers B_1, B_2, ..., B_n. While the amount of such matter left clinging to a weighing hopper is extremely small for one weighing operation by that hopper, the total amount which can accumulate over a large number of weighing operations is significant. Accordingly, a computer scale incorporates an automatic zero adjustment circuit which automatically applies a zero adjustment to the weight s nsors associated with the resp ctive w ighing h ppers. Wh n a preset numb r f weighing operati ns have been p rform d, the automatic zero adjustment circuit is adapted to automatically adjust th z ro point of the weight sensor belonging to the weighing hopper which has performed said pres t number f weighing operations. The zero adjustment referred to here is f r th purpose of setting the output value of a weight sensor to zero when the corresponding weighing hopper is empty. This output value of the weight sensor when the hopper is empty is referred to as the zero point deviation.

Often the articles which are to be weighed exhibit a viscous or sticky property and have a relatively large unit weight, namely the weight of an individual article, such as pieces of uncooked meat. In weighing such articles there are instances where several pieces or portions thereof attach themselves to the walls of a weighing hopper, as occurs with the various residua mentioned above. In the case of these heavier stickier articles, however, the conventional method of zero adjustment cannot distinguish between their attachment to the hoppers and the attachment of the abovementioned residua, so that same zero adjustment is applied to the weight sensor in both cases. If the weighing hopper whose weight sensor is zero-adjusted has an article or portion thereof clinging to it, weight can be sensed correctly by the sensor only as long as the article remains attached. Since the clinging article or portion is comparatively heavy, however, it will almost never remain attached to the hopper permanently but will eventually fall after repeated weighing operations together with the other articles which are released from the hopper. It is obvious that an error will result when the zero adjustment is applied with articles or fragments thereof clinging to a weighing hopper, followed by the dislodging and dropping of said articles or fragments into the chute C. Specifically, the output of the weight sensor belonging to the weighing hopper from which the clinging matter has fallen will include an error w_o which will prevail until the next zero adjustment, the error w_o representing the weight of the formerly attached matter. With such a conventional zero adjustment method, in other words, there are cases where weighing cannot be performed with a high level of accuracy.

DE—A—2,323,750 discloses a method of carrying out a series of weighing operations using a weighing machine which is loaded in turn with respective quantities of material to be weighed in the individual operations and is discharged after each operation of the series, wherein after such a discharge, before being loaded for the next weighing operation the deviation of the unloaded weight read-out of the machine from a zero value thereof set prior to commencement of the said series of weighing operations is available as a zero-point deviation value, and this value is compared with a preset range of acceptable deviation values, whereafter, if but only if the said value is within the preset rang , that value is stored in a regist r and the load d weight read-out obtained fr m th next operation f the series is subject d t zero-point adjustment by subtracting therefrom the stored zero-point deviation value. How-

ever, according t this prior art m thod, whenever the zero-p int deviation value is outside the pres t range, i. . whenever the deposit built up in the weighing hopper reaches or exc eds a critical quantity, the execution of further weighing operations is inhibited until the deposit has been removed from the weighing hopper. It is possible, in this case, that this may result in unnecessarily frequent interruption of the weighing operations.

According to one aspect of the present invention, there is provided a method of carrying out a series of weighing operations using a weighing machine which is loaded in turn with respective quantities of material to be weighed in the individual operations and is discharged after each operation of the series, wherein after such a discharge, before being loaded for the next weighing operation the deviation of the unloaded weight read-out of the machine from a zero value thereof set prior to commencement of the said series of weighing operations is available as a zero-point deviation value, and this value is compared with a preset range of acceptable deviation values, whereafter, if but only if the said value is within the preset range, that value is stored in a register and the loaded weight read-out obtained from the next operation of the series is subjected to zero-point adjustment by subtracting therefrom the stored zero-point deviation value; characterised in that if the said zero-point deviation value is outside the said range this occurrence is registered in a counter and the next operation of the series is subjected to zero-point adjustment on the basis of the last-stored zero-point deviation value that was within the said preset range, unless the count registered in the said counter, which counter is reset whenever the said zero-point deviation value is found to be within the said preset range, has a preselected value, greater than unity, whereupon a alarm response is provided.

According to another aspect of the present invention, there is provided apparatus for carrying out a series of weighing operations using a weighing machine which is loaded in turn with respective quantities of material to be weighed in the individual operations and is discharged after each operation of the series, which apparatus comprises in addition to the said weighing machine: data transfer means connected with a measurement signal output of the machine for providing as a zero-point deviation value, after each discharge of the series and before the machine is loaded for the next weighing operation, the deviation of the unloaded weight read-out of the machine from a zero value thereof set prior to commencement of the said series of weighing operations; comparison means connected for comparing the said zero-point deviation value with a preset range of acceptable deviation values; and zero-point adjustment means operativ , wh n the said zero-p int deviation value is within the said pr set range, to store that deviation value and t bring about zer -point adjustment of the loaded weight read-out obtained from th next operation f the series by subtracting therefrom the stored zero-point deviation value; characterised by c ntrol m ans, including a counter, p rative when th said zero-point deviation value is found to be outside the said range to register this occurrence in the counter and to cause the zero-point adjustment of the next weighing operation of the said series to be based on the last-stored zero-point deviation value that was within the said preset range, unless the count registered in the said counter has a preselected limiting value, greater than unity, whereupon the said control means bring about an alarm response, the counter being reset by the control means whenever the said zero-point deviation value is found by the comparison means to be within the said preset range.

Reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 shows a diagrammatic view of general features of a computer scale;

Fig. 2 shows a diagrammatic view for describing the structure and operating principle of a computer scale to which the present invention can be applied;

Fig. 3 is a block diagram of a zero adjustment control apparatus for practising the zero adjustment control operation of the present invention;

Fig. 4 is a block diagram of a channel selection circuit included in the zero adjustment control apparatus of Fig. 3; and

Fig. 5 is block diagram of an automatic zero adjusting circuit included in the zero adjustment control apparatus of Fig. 3.

In Fig. 2, MS denotes a main feeder of vibratory conveyance type. Articles to be weighed, which will be referred to hereinafter merely as "articles", are introduced into the main feeder MS and imparted with vibratory motion so as to be dispersed radially outward from the center of the main feeder. CN, CN, ... denote n-number of weighing sections which are arranged around the main feeder MS along radially extending lines to receive the articles dispersed by the main feeder. Each weighing section CN includes a dispersing feeder CN_a, a holding vessel CN_b, a holding vessel gate CN_c, a weighing hopper CN_d, a weight sensor CN_e, and a weighing hopper gate CN_f. The dispersing feeder CN_a comprises an independently vibratable conveyance device for feeding the articles by means of vibration, or an independently operable shutter device for delivering the articles in batches. In either case, each dispersing feeder CN_a is so arranged that the articles received from the centrally located main feeder MS can be introduced into the corresponding holding vessel CN_b disposed therebelow. The holding vessel gate CN_c is provided on each holding vessel CN_b in such a manner that the articles received in the holding vessel are rel ased into the weighing hopper CN_d wh n the gate CN_c is op ned. Each weight sensor CN_e is attach d to the corresponding weighing h pper CN_d and is p rabl to measur the weight f the

articles introduced into the w ighing h pper. The weight sensor CN_e is adapted to supply a combinati n control unit (n t shown) with an lectrical signal indicative f the measured weight. The combination control unit then selects the optimum combination of articles that gives a total weight closest to a target weight. Each of the weighing hopper gates CN_f is provided on the corresponding weighting hopper CN_d. The combination control unit, upon receiving the signals from each of the weight sensors CN_e, responds by opening the weighing hopper gates CN_f only of those weighing hoppers CN_d that will give the optimum combination of articles, as mentioned above. The articles from the weighing hoppers CN_d selected in this manner fall through the open weighing hopper gates and are discharged into a common collecting chute GS where they are collected together. The collecting chute GS has the shape of a funnel and is so arranged as to receive the articles from any of the circularly arrayed weighing hoppers CN_d via the hopper gates, which are located above the funnel substantially along its outer rim. The articles received by the collecting chute GS are collected at the centrally located lower end thereof by falling under their own weight or by being forcibly shifted along the inclined wall of the funnel by a mechanical scraper or the like, which is not shown. The collecting chute GS is provided with a timing hopper THP at the lower end thereof for temporarily holding the collected articles. The arrival of an externally applied signal from a packing device or the like causes the timing hopper THP to release the retained articles from the weighing apparatus, namely from collecting chute GS which constitutes the lowermost stage of the apparatus, to a separate item of equipment, such as the packing device.

The operation of the above arrangement will now be described in greater detail. At the beginning the holding vessels CN_b and weighing hoppers CN_d contain a supply of the articles. The weight sensors CN_e associated with the respective weighing hoppers CN_d measure the weights of the articles in each hopper and produce weight values W_1 through W_{10} (when n=10) which are sent to the combination control unit, not shown. The control unit performs an arithmetic combinatory control operation using the weight values W_1 through W_{10} and selects the combination of articles that gives a total weight closest to the set target weight. A drive control unit (not shown) opens the weighing hopper gates CN_f which are selected on the basis of the best combination, whereby the selected weighing hoppers discharge their articles into the collecting chute GS. This will leave the selected weighing hoppers CN_d empty. Now the holding vessel gates CN_c of those holding vessels CN_b corresp nding to the empty weighing hoppers CN_d are opened to introduce a fresh supply of the articles into said weighing h ppers, leaving said holding vess ls empty. Next, the dispersing f ed rs CN_a which correspond to the empty holding vess ls CN_b are vibrated for a predetermined period f time to deliver a fresh supply of the articles to said holding vessels. This restores the weighing apparatus t the initial state to permit resumption f the contr l peration f r s lecting th ptimum weight combinations in the manner described. Thus, weighing by the combinatorial scale may proceeed in continuous fashion by repeating the foregoing steps.

Fig. 3 illustrates a preferred embodiment of a zero adjustment control apparatus according to the present invention. The apparatus includes data transfer means constitued by a channel selection circuit 1 for selecting which of the plurality of weight sensors CN_e, CN_e,... is to be subjected to a zero adjustment. Fig. 4 is a block diagram which illustrates the channel selection circuit 1 in greater detail.

Referring to a Fig. 4, the channel selection circuit 1 is shown to include a decoder 1a for decoding a best combination code CCS provided by a combination control unit which is not shown, a bank of counters 1b, 1b, ... provided for respective ones of the weight sensors CN_e, CN_e,..., a gate 1c which opens to deliver a timing pulse TP in response to the generation of the best combination code CCS (that is, when a corresponding signal CCS' goes to logical "1"), an address counter 1d which counts the timing pulses TP to produce an address signal ADR, a multiplexer 1e for delivering the numerical value M_i from a particular counter 1b specified by the address signal ADR, a preset switch 1f in which a predetermined numerical value M_s is preset, a comparator 1g for comparing the numerical value M_s and the output M_i of the multiplexer 1e and for producing a coincidence signal COI when M_s and M_i coincide, and a multiplexer 1h operable when the coincidence signal COI is produced to deliver the output data (namely the zero point deviation) D_i of the particular weight sensor CN_e designated by the address signal ADR.

To describe the operation of the channel selection circuit 1 we will assume that the best combination code CCS has arrived from the combination control unit, which is not shown. Further, if the weighing hoppers (and hence the weight sensors) and *n* in number, then the best combination code CCS will be expressed as an n-bit binary code. Then, by establishing correspondance between the i-th (where i=1, 2, ..., n) weighing hopper (weight sensor CN_e) and the i-th bit of said binary code, the best combination code CCS may be expressed, for example, in the form 0100100111, where the assumption is that there are ten weighing hopper or weight sensors. The code 0100100111 indicates a combination made up of the second, fifth, eighth, ninth and tenth weighing hoppers or weight sensors. The best combination code CCS is decoded by the decoder 1a to count up, by one step (i.e. +1), th num rical value in th se counters 1b, 1b, ... corresponding to the weighing hoppers which hav been sel cted as giving the b st combination. When the b st combination code CCS is g n rated, the

corresponding signal CCS' g s t logical "1", opening th gate 1c so that th addr ss counter 1d may start counting the timing pulses TP. Whenever a timing pulse arrives from the gate 1c the address signal ADR provided by the address counter 1d is incremented by one step, the multiplexer 1e responding by supplying the comparator 1g with the numerical value $M_1, M_2, \ldots, M_n$ from the counter 1b, 1b, ... specified by the address signal ADR, which counter corresponds to the 1st, 2nd, ..., n-th weight sensor CN_e, CN_e ..., CN_e. Upon receiving the designated numerical value M_i from the multiplexer 1e, the comparator 1g compares M_i with the numerical value M_s set in the preset switch 1f and, when they coincide, produces the coincidence signal COI and clears the counter which stores the value M_i. The multiplexer 1h responds to the coincidence signal COI by delivering the output data (the zero point deviation) D_i of the weight sensor CN_e designated by the address signal ADR.

The foregoing operation is repeated whenever the address signal ADR is incremented by the generation of a timing pulse TP, these being produced with a suitable periodicity. When this operation is completed for the numerical values M_1 through M_n for all n of the counters 1b, this marks the end of one complete operating cycle of the channel selection circuit 1 based on the particular best combinatin code received by the decoder 1a.

In summary, then, the channel selection circuit 1 is so arranged that when a certain weighting hopper has been selected a preset number of times M_s (set in switch 1f) as being one which contributes to the best combination, the weight sensor associated with said hopper is designated and its output data, namely the zero point deviation D_i, is delivered to the circuitry connected to the output side of the selection circuit 1.

Returning now to Fig. 3, the zero adjustment control apparatus further includes comparators 2, 3 which receive the zero point deviation D_i obtained from the weight sensor CN_e selected by the channel selection circuit 1 in the manner described above. The comparators 2, 3 compare the magnitude of the zero point deviation D_i with preset error limits $-w$ and $+w$ (in grams), respectively. A first AND gate 4 receives the output signals of the comparators 2, 3 and produces a pulse when these two outputs coincide. More specifically, the first AND gate 4 develops an output S_4 only when the zero point deviation D_i from the selected weight sensor CN_e is smaller than $+w$ grams and larger than $-w$ grams. The output S_4 of the AND gate 4 is applied to an OR gate 5 whose output S_5 is in turn connected to a second AND gate 6 which receives also a comparison end signal S_1 generated upon the completi n f the comparison peration mentioned ab ve. The AND gat 6 takes th AND of signals S_1, S_5. A third AND gate 7 receives the output S_5 f the OR gate 5 after inversion by an inverter 8, as well as the comparison end signal S_1, and is adapted to take the AND f these tw signals. An R—S flip-flop 9 is cleared by the outputs S_6 f th second AND gat 6 and set by th utput S_7 of the third AND gates 7 t pr duce a zero adjustment inhibit signal S_2. A common counter 10 counts the number of times the zero adjustment inhibit signal S_2 is produced by the flip-flop 9. The counter 10 is cleared by the output S_6 of the second AND gate 6. A preset switch 11 is provided for setting a numerical value N which is applied to a comparison circuit 12 along with the output of the counter 10. The comparison circuit 12 issues an alarm signal S_3 when the numerical value N from the preset switch 11 and the numerical value supplied by the counter 10 coincide. Designated at numeral 13 is an automatic zero adjusting circuit which will be described in greater detail with reference to Fig. 5.

In Fig. 5 the automatic zero adjusting circuit 13 is shown to include n-number of registers 13a, 13a, ... provided for respective ones of the weight sensors CN_e, CN_e, ..., a counter 13b for generating all possible combinations of the n-number of weight sensors CN_e, CN_e, ..., these combinations being 2^n-1 in number, multiplexers 13c, 13d, 13e, and an arithmetic circuit 13f. The registers 13a, 13a, ... store the zero point deviations obtained from the corresponding weight sensors CN_e, CN_e, ..., CN_e.

The automatic zero adjusting circuit 13 operates in the following manner. When the signal S_6 arrives from the output of the second AND gate 6, the zero point deviation D_i from the particular weight sensor CN_e designated by the address signal ADR (Fig. 4) is planted in the register 13a corresonding to this weight sensor to update the contents of the register. (In a case where the zero adjustment inhibit signal S_2 arrives from the flip-flop 9, however, none of the registers 13 is updated). The result of updating the register is that, in an arithmetic combinatory control operation for providing the best combination, the zero point deviation D_i stored in a register 13a is subtracted from the weight value W_i of the articles measured by the corresponding weight sensor CN_e. In other words, a zero adjustment is automatically performed in which the difference obtained by subtracting D_i from W_i is delivered as the true measured value. This will now be described in further detail.

In accordance with the arithmetic combinatory operation, the counter 13b generates a pattern BTP of all possible 2^n-1 combinations. That is, for n-number of weighing hoppers (weight sensor), n combinations are possible when each combination is composed of one weighing hopper, $n(n-1)/2$; combinations are possible when each combination is composed of two weighing hoppers, and, in general, $n(n-1)(n-2) \ldots (n-r+1)/r!$ combinations are possible when each combination is composed of r-number of w ighing hoppers. Thus the total number of different combinations which can be formed is 2^n-1. Accordingly, if the n-bit binary counter 13b is made to count 2^n-1 timing pulses TP', then a total or 2^n-1 different bit patterns, from 000...001

to 111...111, will b generated. Then, if the first bit is mad to correspond to the first weighing hopp r, th second bit to the s cond weighing hopper, and the third thr ugh n-th bits t th third through n-th weighing hoppers, then the bit pattern will be an indication of the abovementioned combination pattern BTP. The combination pattern BTP is applied to the multiplexers 13d, 13e, as illustrated in Fig. 5. The multiplexer 13d responds to the particular combination pattern BTP by selecting the specified zero point deviations D_i stored in predetermined ones of the registers 13a, these values of D_i being delivered to the arithmetic circuit 13f. Likewise, the multiplexer 13e also responds to this combination pattern BTP by selecting the specified read-outs (the weights of the articles) W_i of predetermined ones of the weight sensors CN_e, these also being applied to the arithmetic circuit 13f. For instance, when n=10, assume that the combination pattern BTP is 1101010001. This means that the arithmetic circuit 13f will receive the outputs W_1, W_2, W_4, W_6, W_{10} of the weight sensors CN_e associated with the first, second, fourth, sixth and tenth weighing hoppers, and the zero point deviations D_1, D_2, D_4, D_6, D_{10} of said weight sensors. The arithmetic circuit 13f is adapted to perform the subtractions W_1-D_1, W_2-D_2, W_4-D_4, W_6-D_6, $W_{10}-D_{10}$, and to send the results to a combinatory arithmetic unit, which is not shown.

A single cycle proceeds as follows. When a weight sensor CN_e which requires a zero adjustment is selected by the channel selection circuit 1, the zero point deviation D_i from the selected weight sensor is applied to the comparators 2, 3. The comparators 2, 3 compare the magnitude of the received zero point deviation D_i with the preset allowable zero point deviation limits $-w$ grams and $+w$ grams. The comparator 2 produces a pulse when the zero point deviation D_i is smaller than *w* grams, and the comparator 3 when the absolute value $|D_i|$ of the negative zero point deviation D_i is larger than *w* grams. When the zero point deviation D_i, which is the output of the selected weight sensor, is within the range $-w$ to $+w$, therefore, the output S_4 of the first AND gate 4 goes to logical "1". This sends the output S_5 of OR gate 5 to logical "1", so that one input to the second AND gate 6 is high and one input to the third AND gate 7 low, by virtue of the inverter 8. When the comparison end signal S_1 (logical "1") arrives at the other input terminal of each of the AND gates 6, 7 under these conditions, the output S_6 of AND gate 6 goes high and the output S_7 of AND gate 7 goes low. The "1" logic from the second AND gate 6, mamely signal S_6, clears the flip-flop 9 and the counter 10, so that the flip-flop 9 cannot produce the zero adjustment inhibit signal S_2. The automatic zero adjusting circuit 13 therefore executes a zero adjustment.

Assume now the converse situation wherein th zer point d viation D_i from the w ight sensor selected by the channel selection circuit 1 is utside the preset rang of $-w$ grams to $+w$ grams d termined by th comparators 2, 3. In such case only on f the two comparators will produce a pulse, sending the output S_4 of the first AND gate 4 t logical "0". The output S_5 of the OR gate 5 ther fore also goes low, so that one input to the second AND gate 6 is low and one input to the third AND gate 7 high. When the comparison end signal S_1 (logical "1") arrives at the other input terminal of each of the AND gates 6, 7 under these conditions the output S_6 of AND gate 6 goes low and the output S_7 of AND gate 7 goes high. The "1" logic from the third AND gate 7, namely signal S_7, sets the flip-flop 9. When this occurs, the zero adjustment inhibit signal S_2 appears at the set output terminal of the flip-flop and inhibits the instant zero adjustment while at the same time incrementing the counter 10.

It should be noted that it may be desired to perform the zero adjustment compulsorily even though the zero point deviation D_i from the weight sensor is outside the range of $-w$ grams to $+w$ grams. This can be achieved by using a manual switch or the like to apply the OR gate 5 with a high level signal S_8 to assure that the output S_5 of OR gate 5 will be a "1" despite the low level output of AND gate 4. The high level of signal S_5 will initiate the zero adjustment.

When the zero point deviation from the channel selection circuit 1 has been subjected to the comparison operation in the manner described above followed by the subsequent processing which is based on the result of the comparison, the channel selection circuit 1 delivers the next zero point deviation on the basis of which the foregoing comparison operation and associated processing take place. This is repeated each time the channel selection circuit 1 delivers a zero point deviation D_i. When the content of counter 10 attains the numerical value N which has been preset in the preset switch 11, this is sensed by the comparison circuit 12 which responds by generating the alarm signal S_3.

The foregoing description deals with a case where the invention is applied to a computer scale having an automatic zero ajustment apparatus. It should be noted, however, that the invention can also be applied to a case where a large number of discrete weighing machines having an automatic zero adjustment apparatus are arranged in a row and employed simultaneously. The invention can be applied to a single weighing machine having a zero adjustment apparatus by deleting the channel selection circuit 1.

The present invention as described and illustrated hereinabove is so arranged that when a weighing machine having an automatic zero adjustment apparatus is subjected to a zero adjustment, the variation in the zero point is investigated to determine whether it lies within preset limits. When it do s lie within these limits the zero adjustment is allowed t proceed; when it does n t th zero adjustment is inhibit d. Accordingly, when a article is clinging to a weighing hopper to give rise to a significant shift in the zer p int at th time of a z ro adjustment, said

zer adjustmemt is n t allowed to ccur. This makes it p ssible t prevent a significant shift in the zero p int then, f ll wing a z r adjustment which is performed while articles are clinging to a weighing hopper, said articles are dislodged and fall from the hopper. An alarm is issued to notifiy the operator of an abnormality wherein an article clings to a weighing hopper without falling for a certian period of time, as indicated by the generation of a predetermined number of zero adjustment inhibit signals.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

Claims

1. A method of carrying out a series of weighing operations using a weighing machine (CN_e) which is loaded in turn with respective quantities of materials to be weighed in the individual operations and is discharged after each operation of the series, wherein after such a discharge, before being loaded for the next weighing operation the deviation of the unloaded weight read-out of the machine from a zero value thereof set prior to commencement of the said series of weighing operations is available as a zero-point deviation value, and this value is compared with a preset range of acceptable deviation values, whereafter, if but only if the said value is within the preset range, that value is stored in a register (13a) and the loaded weight read-out obtained from the next operation of the series is subjected to zero-point adjustment by subtracting therefrom the stored zero-point deviation value;
characterised in that if the said zero-point deviation value is outside the said range this occurrence is registered in a counter (10) and the next operation of the series is subjected to zero-point adjustment on the basis of the last-stored zero-point deviation value that was within the said preset range, unless the count registered in the said counter (10), which counter is reset whenever the said zero-point deviation value is found to be within the said preset range, has a preselected value, greater than unity, whereupon an alarm response is provided.

2. A method as claimed in claim 1, wherein between each pair of successive weighing operations of the said series the weighing machine (CN_e) is used to carry out a preset number (M_e-1) of further weighing operations, after each of which the weighing machine is discharged, each of which further operations is subjected to zero-point adjustment on the basis of the last-stored zero-point deviation value that was within th said preset range.

3. A m thod as calimed in claim 1 or 2, empl yed in respect of each machine (CN_e) of a plurality f such w ighing machines b ing used to carry ut successiv c mbinatorial weighing perations, the said s ries of weighing operations for each individual weighing machine of the said plurality being combinatorial weighing operations in which the individual weighing machine concerned is included in the respective selected combinations.

4. Apparatus for carrying out a series of weighing operations using a weighing machine (CN_e) which is loaded in turn with respective quantities of material to be weighed in the individual operations and is discharged after each operation of the series, which apparatus comprises in addition to the said weighing machine (CN_e):
data transfer means (1) connected with a measurement signal output of the machine for providing as a zero-point deviation value, after each discharge of the series and before the machine is loaded for the next weighing operation, the deviation of the unloaded weight read-out of the machine (CN_e) from a zero value thereof set prior to commencement of the said series of weighing operations;
comparison means (2, 3) connected for comparing the said zero-point deviation value with a preset range of acceptable deviation values; and
zero-point ajustment means (13) operative, when the said zero-point deviation value is within the said preset range, to store that deviation value and to bring about zero-point adjustment of the loaded weight read-out obtained from the next operation of the series by subtracting therefrom the stored zero-point deviation value;
characterised by control means (4 to 12), including a counter (10), operative when the said zero-point deviation value is found to be outside the said range to register this occurrence in the counter (10) and to cause the zero-point adjustment of the next weighing operation of the said series to be based on the last-stored zero-point deviation value that was within the said preset range, unless the count registered in the said counter (10) has a preselected limiting value, greater than unity, whereupon the said control means (4 to 12) bring about an alarm response, the counter (10) being reset by the control means whenever the said zero-point deviation value is found by the comparison means to be within the said preset range.

5. Apparatus as claimed in claim 4, wherein the said data transfer means (1) comprise a further counter (1b) and are operative when material is discharged from the weighing machine (CN_e) to register this occurrence in the said further counter (1b), to compare the count (M_i) registered in that counter with a preset count value (M_e) and, when that count (m_i) is less than the said preset count value (M_e), to inhibit such comparison of the zero-point deviation value with the said preset range of acceptable deviation values, the said further counter (1b) being reset by the said means (1) whenever the c unt (M_i) register d in the said further counter (1b) is found to b equal t the said preset count valu (M_e).

6. Apparatus as claimed in claim 4 or 5, wherein the said weighing machine (CN_e) is on of a

plurality of such weighing machines (CN_e) connected with such data transfer means (1), comparison means (2, 3), zero-p int adjustment means (13) and control means (4 t 12), and wherein the said apparatus further comprises combination selection means for selecting a combination of those weighing machines (CN_e) and bringing about discharge of those selected weighing machines; the said comparison means (2, 3) being operative, after such a combined discharge, to compare the individual zero-point deviation values available from the respective weighing machines of the selected combination successively with the said preset range of acceptable deviation values, and the said counter (10) of the control means (4 to 12) being operative for all the machines (CN_e) in common so as to accumulate a count of the total number of successive occurrences of out-of-range deviation values.

Patentansprüche

1. Verfahren zum Ausführen einer Serie von Wägvorgängen unter Verwendung einer Wägmaschine (CN_e), die der Reihe nach mit jeweiligen in den einzelnen Vorgängen zu wägenden Materialmengen geladen und nach jedem Vorgang der Serie entladen wird, bei dem nach einer Entladung, bevor die Wägmaschine für den nächsten Wägvorgang geladen wird, die Abweichung des Leergewichts-Lesewertes der Maschine von einem vor Beginn der Serie von Wägvorgängen eingestellten Nullwert der Maschine als Nullpunkt-Abweichungswert verfügbar ist, und dieser Wert mit einem voreingestellten Bereich akzeptabler Abweichungswerte verglichen wird, wonach dann und nur dann, wenn der Wert innerhalb des voreingestellten Bereiches liegt, dieser Wert in einem Register (13a) gespeichert wird und der beim nächsten Vorgang der Serie erhaltene Ladegewicht-Lesewert einer Nullpunkt-Adjustierung unterzogen wird, indem von ihm der gespeicherte Nullpunkt-Abweichungswert subtrahiert wird;

dadurch gekennzeichnet, daß, falls der Nullpunkt-Abweichungswert außerhalb des genannten Bereiches liegt, dieses Vorkommen in einem Zähler (10) registriert wird und der nächste Vorgang der Serie auf der Basis des zuletzt gespeicherten Nullpunkt-Abweichungswertes, der innerhalb des voreingestellten Bereiches lag, der Nullpunkt-Adjustierung unterzogen wird, wenn nicht der Zählstand, der in dem Zähler (10) registriert ist, welcher rückgestellt wird, wann immer der Nullpunkt-Abweichungswert als innerhalb des voreingestellten Bereiches liegend erkannt wird, einen vorgewählten Wert hat, der größer als der Einheitswert ist, woraufhin als Antwort ein Alarm erzeugt wird.

2. Verfahren nach Anspruch 1, bei dem zwischen jedem Paar sukzessiver Wägvorgäng der S ri die Wägmaschine (CN_e) zum Ausführen ein r v reingestellten Anzahl (M_s-1) weiterer Wägv rgäng verwendet wird, wobei nach jedem dieser weit ren Wägvorgänge die Wägmaschin entlad n wird, und wob i jeder der weiteren Vorgänge auf d r Basis des zuletzt gesp icherten Nullpunkt-Abweichungswertes, der innerhalb des voreingest llten B reich s lag, der Nullpunkt-Adjustierung unterzogen wird.

3. Verfahren nach Anspurch 1 oder 2, angewandt für jede Maschine (CN_e) einer Gruppe der zum Ausführen sukzessiver kombinatorischer Wägvorgänge verwendeten Wägmaschinen, wobei die Serie von Wägvorgängen für jede einzelne Wägmaschine der Gruppe aus kombinatorischen Wägvorgängen besteht, bei den en die betreffende einzelne Wägmaschine in den jeweiligen gewählten Kombinationen enthalten ist.

4. Vorrichtung zum Ausführen einer Serie von Wägvorgängen unter Verwendung einer Wägmaschine (CN_e), die der Reihe nach mit jeweiligen in den einzelnen Vorgängen zu wägenden Materialmengen geladen und nach jedem Vorgang der Serie entladen wird, wobei die Vorrichtung zusätzlich zu der Wägmaschine (CN_e) aufweist:

eine Datenübertragungseinrichtung (1), die mit einem Meßsignalausgang der Maschine verbunden ist und nach jeder Entladung der Serie und bevor die Maschine für den nächsten Wägvorgang geladen wird, die Abweichung des Leergewicht-Lesewertes der Maschine (CN_e) von einem vor Beginn der Serie von Wägvorgängen eingestellten Nullwert der Maschine als Nullpunkt-Abweichungswert liefert;

Vergleichseinrichtungen (2, 3), die zum Vergleichen des Nullpunkt-Abweichungswertes mit einem voreingestellten Bereich akzeptabler Abweichungswerte geschaltet sind; und

eine Nullpunkt-Adjustiereinrichtung (13), die, wenn der Nullpunkt-Abweichungswert innerhalb des voreingestellten Bereiches liegt, diesen Abweichungswert speichert und die Nullpunkt-Adjustierung des beim nächsten Vorgang der Serie erhaltenen Ladegewicht-Lesewertes veranlaßt, indem von dem Ladegewicht-Lesewert der gespeicherte Nullpunkt-Abweichungswert subtrahiert wird;

gekennzeichnet durch Steuereinrichtungen (4 bis 12) mit einem Zähler (10), der, wenn der Nullpunkt-Abweichungswert als außerhalb des genannten Bereiches liegend erkannt wird, dieses Vorkommen registriert und veranlaßt, daß die Nullpunkt-Adjustierung des nächsten Wägvorgangs der Serie auf dem zuletzt gespeicherten Nullpunkt-Abweichungswert basiert, der innerhalb des voreingestellten Bereiches lag, wenn nicht der in dem Zähler (10) registrierte Zählstand einen vorgewählten Begrenzungswert hat, der größer als der Einheitswert ist, woraufhin die Steuereinrichtungen (4, bis 12) als Antwort einen Alarm erzeugen, wobei der Zähler (10) von den Steuereinrichtungen immer dann rückgestellt wird, wenn der Nullpunkt-Abweichungswert von den Vergleichseinrichtungen als innerhalb des voreingestellten Bereiches liegend erkannt wird.

5. Vorrichtung nach Anspruch 4, bei der die Datenübertragungseinrichtung (1) einen weit ren Zähler (1b) aufw ist und, wenn Material aus der Wägmaschine (CN_2) entladen wird, dieses Vorkomm n in dem weiteren Zähler registriert, den

in diesem Zähler registrierten Zählstand (M_i) mit einem v reingest llten Zählwert (M_s) vergleicht und, wenn der Zählstand (M_i) geringer ist als der v reingest llte Zählwert (M_s), den Vergleich des Nullpunkt-Abweichungswertes mit dem voreingestellten Bereich akzeptabler Abweichungswerte verhindert, wobei der weitere Zähler (1b) von der Einrichtung (1) immer denn rückgestellt wird, wenn der in dem weiteren Zähler (1b) registrierte Zählstand (M_i) als gleich mit dem voreingestellten Zählwert (M_s) erkannt wird.

6. Vorrichtung nach Anspruch 4 oder 5, bei der die Wägmaschine (CN_s) eine aus einer Gruppe derartiger Wägmaschinen (CN_s) ist, die mit der Datenübertragungseinrichtung (1), den Vergeleichseinrichtungen (2, 3), der Nullpunkt-Adjustiereinrichtung (13) und den Steuereinrichtungen (4 bis 12) verbunden sind, und bei der die Vorrichtung ferner eine Kombinations-Selektiereinrichtung zum Wählen einer Kombination dieser Wägmaschinen (CN_s) und zum Veranlassen des Entladens dieser gewählten Wägmaschinen aufweist; wobei die Vergleichseinrichtungen (2, 3) nach einer derartigen kombinierten Entladung die einzelnen von den jeweiligen Wägmaschinen der gewählten Kombination verfügbaren Nullpunkt-Abweichungswerte sukzessive mit dem voreingestellten Bereich akzeptabler Abweichungswerte vergleichen, und der Zähler (10) der Steuereinrichtungen (4 bis 12) für alle Maschinen (CN_s) gemeinsam den Zählwert der Gesamtanzahl des sukzessiven Vorkommens außerhalb des Bereiches liegender Abweichungswerte akkumulierend bestimmt.

Revendications

1. Procédé pour effectuer une série d'opérations de pesage à l'aide d'une machine de pesage (CN_s) qui est chargée successivement de quantités respectives de matière à peser lors d'opérations individuelles et qui est déchargée après chaque opération de la série, dans lequel, après ce déchargement, avant le chargement pour l'opération de pesage suivante, l'écart entre le poids déchargé affiché par la machine et une valeur zéro de celui-ci établie avant le commencement de ladite série d'opérations de pesage est utilisable comme valeur d'écart de point-zéro, et cette valeur est comparée avec une gamme préétablie de valeurs d'écarts acceptables, après quoi, si, mais uniquement si, ladite valeur se situe dans la gamme préétablie, la valeur est mémorisée dans un registre (13a) et l'affichage de poids chargé obtenu lors de l'opération suivante de la série est soumis à un réglage de point zéro en soustrayant de cet affichage la valeur mémorisée d'écart de point zéro:

caractérisé en ce que, si ladite valeur d'écart de point zéro se situe en dehors de ladite gamme, ce fait est enregistré dans un compteur (10) et l'opération suivante de la série subit un réglage du point zéro sur la base de la dernière valeur mémorisée d'écart d point zéro située dans ladite gamme préétablie, à m ins qu le compte enregistré dans le c mpteur (10), lequ l compteur est remis à zéro chaque fois qu'il est constanté que ladite val ur d'écart de point zéro se trouv dans ladite gamme préétabli , n'ait une valeur préablement choisie, supérieure à l'unité, auquel cas une réponse d'alarme est fournie

2. Procédé selon la revendication 1, dans lequel entre chaque paire d'opérations de pesage successives de ladite série la machine de pesage (CN_s) est utilisée pour effectuer un nombre préétabli (M_s-1) d'autres opérations de pesage, après chacune desquelles la machine de pesage est déchargée, chacune de ces autres opérations étant soumise à un réglage du point zéro sur la base de la dernière valeur enregistrée d'écart de point zéro qui se situait dans ladite gamme préétablie.

3. Procédé selon la revendication 1 ou 2, employé en ce qui concerne chaque machine (CN_s) d'une pluralité de telles machines de pesage utilisées pour effecteur des opérations successives de pesage combinatoire, ladite série d'opérations de pesage pour chaque machine de pesage particulière de ladite pluralité étant des opérations de pesage combinatoire au cours desquelles la machine de pesage particulière concernée est impliquée dans les combinaisons respectives choisies.

4. Appareil pour effectuer une série d'opérations de pesage à l'aide d'une machine de pesage (CN_s) successivement chargée de quantités respectives de matière à peser au cours des différentes opérations et déchargée après chaque opérations de la série, lequel appareil comprend en plus de la machine de pesage (CN_s):

des moyens (1) de transfert de données reliés à une sortie de signaux de mesure de la machine afin de fournir comme valeur d'écart de point zéro, après chaque déchargement de la série et avant que la machine ne soit chargée pour l'opération de pesage suivante, l'écart entre le poids déchargé affiché par la machine (CN_s) et une valeur zéro de celui-ci établie avant le commencement de ladite série d'opérations de pesage;

des moyens de comparaison (2, 3) reliés pour comparer ladite valeur d'écart de point zéro avec une gamme préétablie de valeurs d'écarts acceptables; et

un moyen (13) de réglage du point zéro servant, lorsque ladite valeur d'écart de point zéro se situe dans ladite gamme préétablie, à enregistrer cette valeur d'écart et à provoquer le réglage de point zéro de l'affichage de poids chargé obtenu lors de l'opération suivante de la série en soustrayant de cet affichage la valeur mémorisée d'écart de point zéro;

caractérisé par des moyens de commande (4 à 12) comprenant un compteur (10), servant lorsqu'il est constaté que ladite valeur d'écart de point zéro se trouve en deh rs de ladite gamme à enregistrer ce fait dans le compteur (10) et à amener le réglage du point zéro de l'opération de pesage suivante de ladite série à être basé sur la dernière valeur mémorisée d'écart du point zéro située dans ladite gamme préétablie, à m ins qu

le compt enregistré dans ledit compteur (10) n'ait une val ur limitative préalablement choisie, supérieure à l'unité, auquel cas lesdits m y ns d command (4 à 12) provoquent une réaction d'alarme, le compteur (10) étant remis à zéro par les moyens de commande chaque fois que les moyens de comparaison constatent que la valeur d'écart de point zéro se situe dans ladite gamme préétablie.

5. Appareil selon la revendication 4, dans lequel les moyens (1) de transfert de données comprennent un autre compteur (1b) et interviennent quand la matière est déchargée de la machine de pesage (CN_e) pour enregistrer ce fait dans ledit autre compteur (1b), afin de comparer le compte (M_i) enregistré dans ce compteur avec une valeur de compte préétablie (M_s) et, lorsque ce compte (M_i) est inférieur à ladite valeur de compte préétablie (M_s), pour interdire cette comparaison de la valeur d'écart du point zéro avec ladite gamme préétablie de valeurs d'écarts acceptables, ledit autre compteur (1b) étant remis à zéro par lesdits moyens (1) chaque fois qu'il est constaté que le compte (M_i) enregistré dans ledit autre compteur (1b) est 'gal à ladite valeur de c mpte préétablie (M_s).

6. Appareil selon la rev ndicati ns 4 u 5, dans lequel la machin d pesag (CN_e) est l'une d'une pluralité de telles machines de pesage (CN_e) reliées aux moyens (1) de transfert de données, aux moyens de comparaison (2, 3), au moyen (13) de réglage du point zéro et aux moyens de commande (4 à 12), et dans lequel ledit appareil comporte en outre un moyen de sélection de combinaisons pour choisir une combinaison de ces machines de pesage (CN_e) et provoquer le déchargement de ces machines de pesage choisies; lesdits moyens de comparaison (2, 3) servant, aprés ce déchargement combine, à comparer les différentes valeurs d'écarts de point zéro pouvant être obtenues des machines de pesage correspondantes de la combinasion choisie, successivement avec ladite gamme préétablie de valeurs d'écarts acceptables, et ledit compteur (10) des moyens de comamnde (4 à 12) intervenant pour toutes les machines (CN_e) en commun de façon à accumuler un compte du nombre total de cas successifs de valeurs d'écarts situées hors de la gamme.

Fig.1 (PRIOR ART)

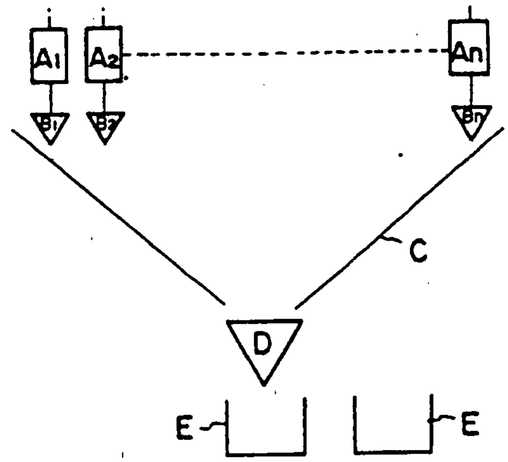


Fig.2 (PRIOR ART)

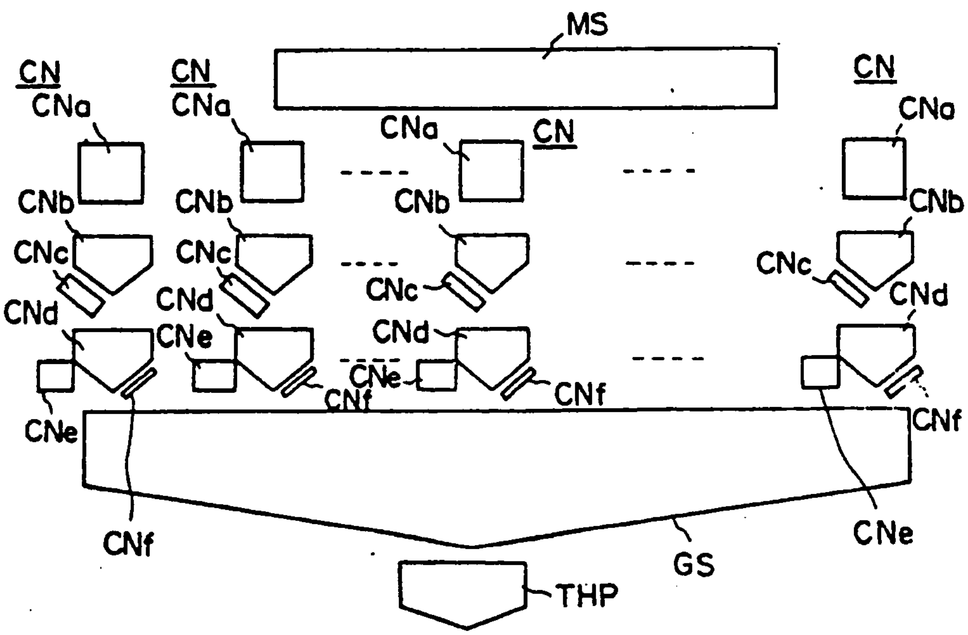


Fig. 3

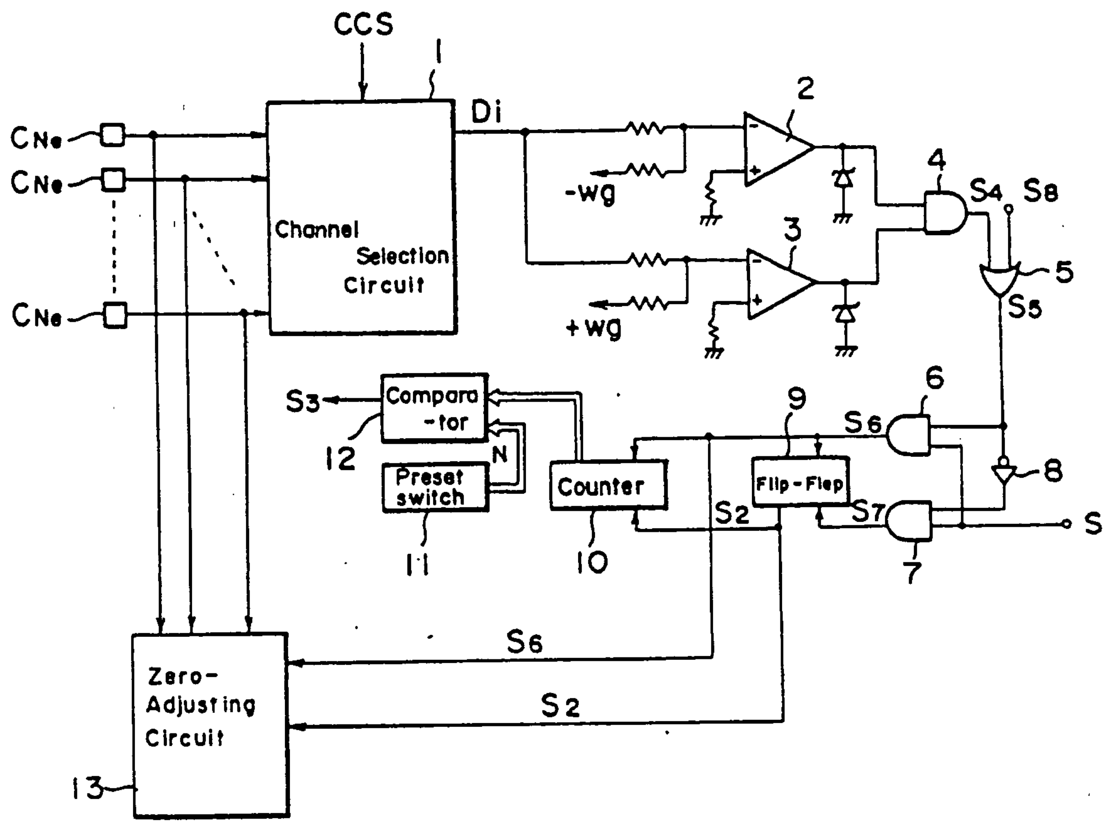
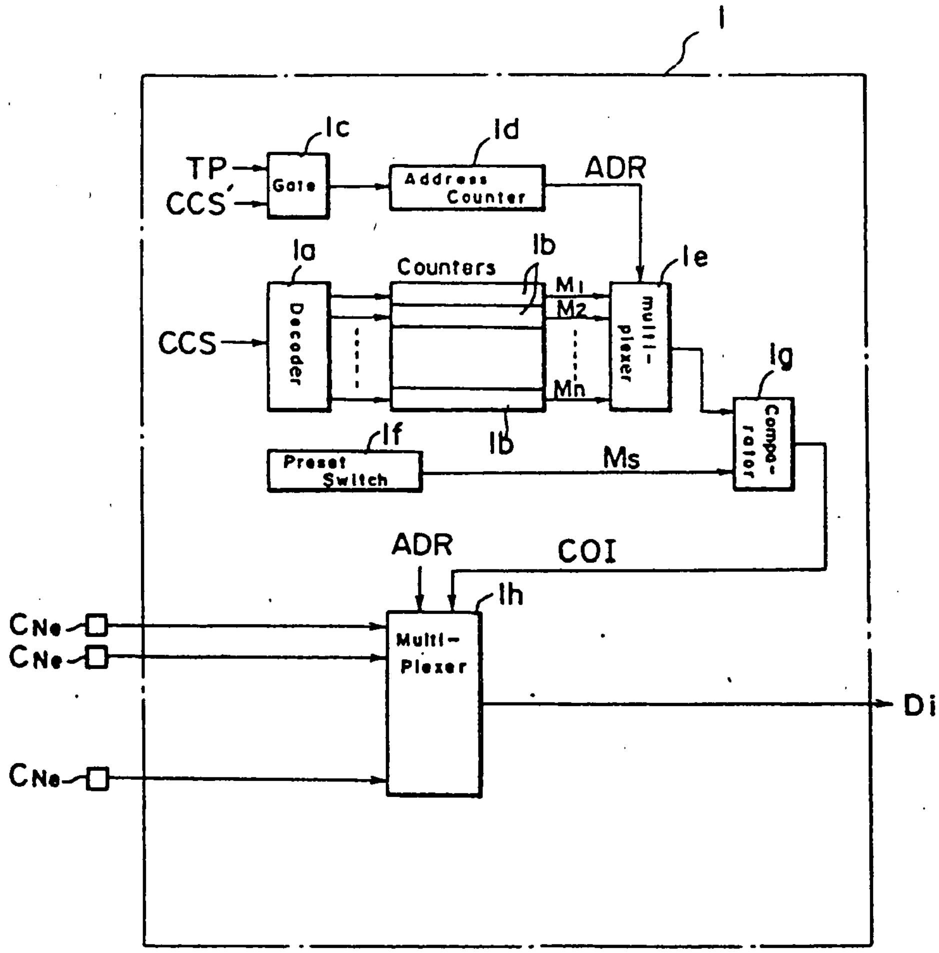

CCS
1
Di
2
-wg
4
S4
S8
3
5
S5
+wg
CNe
CNe
CNe
Channel Selection Circuit
S3
Comparator
12
N
Preset switch
11
Counter
10
9
Flip-Flop
S6
6
8
S2
S7
7
S1
S6
S2
Zero-Adjusting Circuit
13

Fig . 4


1
1c
1d
TP
CCS'
Gate
Address Counter
ADR
1a
Counters
1b
1e
CCS
Decoder
M1
M2
Mn
multi-plexer
1g
1f
1b
Preset Switch
Ms
Compa-rator
ADR
COI
1h
CNe
CNe
CNe
Multi-Plexer
Di

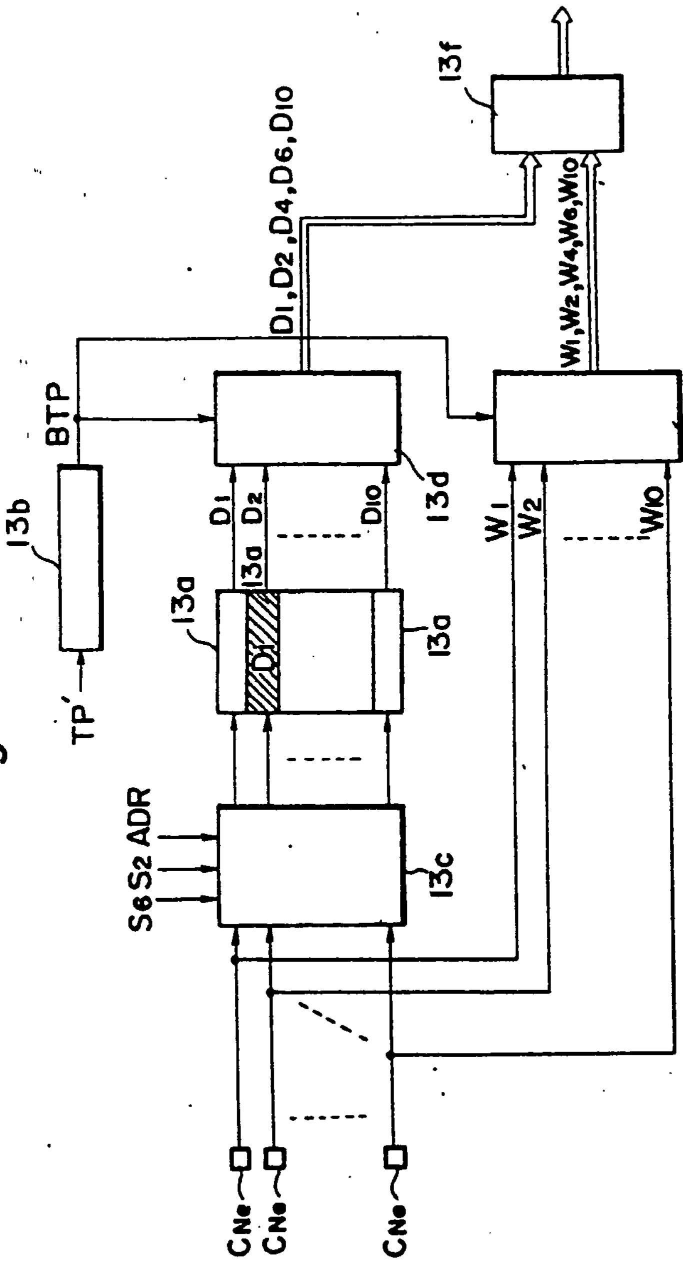

13f
D1, D2, D4, D6, D10
W1, W2, W4, W6, W10
BTP
13b
TP'
13d
13e
13a
13a
13a
D1
D1
D2
D10
W1
W2
W10
S6 S2 ADR
13c
CNe
CNe
CNe

Fig. 5